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CsPbBr3 Nanocrystals based Plastic Scintillator for Ionizing Radiation Detection

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Herein, we study a facile, toxic solvent-free surfactant-dependent mechanochemical synthesis of highly luminescent CsPbBr3 nanocrystals (NCs) and study their scintillation properties. A small amount of surfactant oleylamine (OAM) plays an important role in the two-step ball milling method to control the size and emission properties of the NCs. CsPbBr3 NCs capped with different amounts of surfactant were dispersed in toluene and mixed with polymethyl methacrylate (PMMA) polymer and cast into scintillator discs. We varied perovskite loading concentration in the nanocomposite and studied emission properties. The most intense PL emission was observed from the 2% perovskite-loaded disc, while the 10% loaded CsPbBr3/PMMA disc exhibited the highest radioluminescence (RL) emission from 50 kV X-rays. The strong radioluminescence yield may be attributed to the deep penetration of X-rays into the composite, combined with the large interaction cross-section of the high-Z atoms within the NCs. The nanocomposite disc shows an intense RL emission peak centered at 536 nm and a fast RL decay time of 29.4 ns. We have demonstrated the X-ray imaging performance of a 10% CsPbBr3 NC-loaded nanocomposite disc. The neutron response of the scintillator was further studied by using a commercial PMT and a neutron generator. Thus, low-cost nanocomposite scintillators have great potential for ionizing radiation detection and imaging.

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